HW 6: Due Wednesday March 31

1. (10pts) Consider a pin-pin beam of length L with equal transverse loads of magnitude P in the positive and negative directions at $x = L/4$ and $x = 3L/4$, respectively. By approximately minimizing the potential energy of the system find the displacement field for the beam. Compare your approximation to the exact answer.

2. (10 pts) Carefully derive the matrix equations that would result from using the method of Ritz on an elastic tension-compression bar problem fixed at its left end and subject to both point forces and distributed axial loads.

3. (20 pts) Consider a linear elastic bar with cross-sectional properties $AE = 450 \times 10^6$ lbf and length 5 ft which is built-in at both ends. The bar is loaded with a axial point-force in its center of magnitude 450 kips. Solve for the displacement and strain fields in the bar using the method of Ritz and the basis functions $f_n(x) = \sin(n\pi x/L)$ for $n = 1, 2, 3, \ldots$. How many terms in the expansion are required to reduce the relative L^2 error in the displacements to 1%? Use the exact answer for the error computation. How many terms are needed to do the same for the strains?